

The formation of young B/PS bulges in edge-on barred galaxies

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Abstract. We report about the fact that the stellar population that is born in the gas inflowing towards the central regions can be vertically unstable leading to a B/PS feature *remarkably bluer than the surrounding bulge*. Using new chemodynamical simulations we show that this young population does not remain as flat as the gaseous nuclear disc and buckles out of the plane to form a new boxy bulge. We show that such a young B/PS bulge can be detected in colour maps.

Keywords. galaxies: bulges galaxies: evolution galaxies: formation galaxies: nuclei galaxies: stellar content galaxies: structure methods: n-body simulations

In the generic case of pure N–body simulations, whenever a disc galaxy forms a bar, a B/PS bulge develops in a few dynamical times. In the case of chemodynamical simulations, with gas and star formation/feedback recipes (cf Wozniak & Michel-Dansac (2007), Michel-Dansac & Wozniak (2008) for full details), the B/PS growing process is different and more complicated due to the presence of a young stellar population that is born in the disc. Most of this young population lies in a razor-like central disc during the first 450 Myr, obviously because of the small vertical scaleheight of the initial gas distribution. Since a razor-thin disc is highly unstable the most central part of the disc starts to thicken out the equatorial plane. In roughly a bar rotation period, the vertical distribution gets symmetrically peanut shaped over the central 2 kpc, while the young bar is approximately 8 kpc long (cf. Fig 1, $t = 600$ Myr). At this time, the total mass of the central disc being still low, the thickening process has no clear detectable effect on the whole mass distribution. Then, the old population also starts to buckle out leading to a larger B/PS bulge (cf Fig. 1, $t = 1500$ Myr). Both populations being fully mixed, the two components can only be splitted in numerical simulations.

To observationally detect the young stellar component of a B/PS bulge we have to rely on stellar population tracers, e.g. B–V maps. We thus obtained mock B–V maps calibrating our simulations. The full process is described by Michel-Dansac & Wozniak (2004). We assume that the initial population starts with an age of 10.4 Gyr and has a solar metallicity at $z = 0$.

Due to the colour contrast between both stellar populations, the young B/PS structure is clearly visible (Fig. 2). The dust could however hampered such a detection (Fig. 2, right panels). At $t = 600$ Myr, since the new stellar disc is young and star formation still active, the dust amount should be likely large. Afterward, the peanut-shape widens out as the young disc evolves. The thick part of the disc doubles its radial size in less than 1 Gyr. The vertical scaleheight also increases with time leading to a well-developed peanut-shaped bulge for $t > 1500$ Myr.

The young B/PS structure, being now much more extended both in the radial and

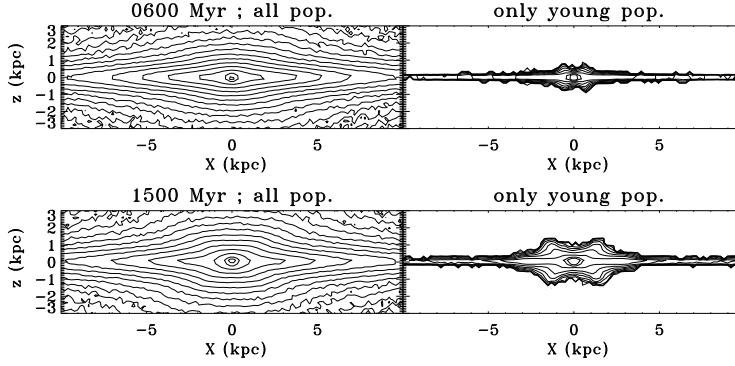


Figure 1. Mass distribution (in log units) of the central 10×5 kpc seen edge-on for $T=600$ (top panel) and 1500 Myr (bottom). Left panel: all stars (old and young populations) are plotted. Right panel: only the young population has been plotted.

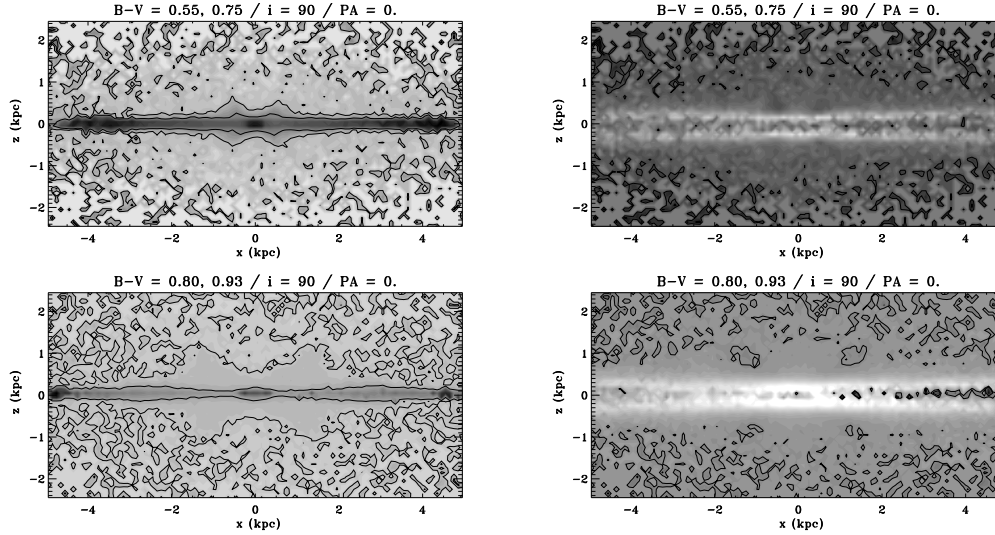


Figure 2. B-V colour maps without (left) and with (right) a dust component for the same fields and times. Bluest region are coded in black. The two isocontours have been chosen as to enhance the boxy feature and are quoted at top of each frame.

vertical direction, is likely detectable even in the presence of dust. Indeed, the height of the B/PS structure is greater than the dust disc scaleheight.

Since the early studies of B/PS bulges, there were many evidences that galaxies hosting such a feature are edge-on barred disc galaxies, and that the B/PS bulges themselves represent the thickest parts of the bars. But stellar populations of B/PS bulges (and their colours) have been rarely studied. Looking for young, blue and small scaleheight B/PS bulge, likely inside older, redder and larger bulge, deserves dedicated surveys.

References

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